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U.S. Department of Transportation
Docket Operations
West Building Ground Floor, Room W12-140
1200 New Jersey Avenue, SE
Washington, DC 20590

Subject: Request for Revision to Exemption No. 10387B, Exemption from Section 25.981(a)(3) of Title 14, Code of Federal Regulations, Lightning Protection of Fuel Tank Systems and Structure

Enclosure(s):
1) Petition for Permanent Partial Exemption – Gulfstream Aerospace Corporation – Lightning Protection of Fuel Tank Systems and Structure – Model GVIII-G800

Reference(s):
1) Regulatory Docket No. FAA-2010-1119, Exemption No. 10387A, dated June 17, 2020, Exemption from Section 25.981(a)(3) of Title 14, Code of Federal Regulations
2) Regulatory Docket No. FAA-2010-1119, Exemption No. 10387B, dated September 16, 2020, Exemption from Section 25.981(a)(3) of Title 14, Code of Federal Regulations
3) Regulatory Docket No. FAA-2017-0269, Exemption No. 17636A, dated March 15, 2018 Exemption from Section 25.981(a)(3) of Title 14, Code of Federal Regulations

ODA Project Number(s): AT-01-2015-0017

Dear Sirs:

In accordance with 14 CFR Part 11, Gulfstream Aerospace Corporation requests consideration to revise Regulatory Docket No. FAA-2010-1119, Exemption No. 10387B, dated September 16, 2020 (Reference 2), originally issued to relieve the Gulfstream GVI model from full compliance with 14 CFR 25.981(a)(3) at amendment 25-102, Lightning Protection of Fuel Tank Systems and Structure (Reference 1) and revised to include the Gulfstream GVIII-G700 model aircraft. This revision to the exemption is being requested to include the Gulfstream GVIII-G800 model aircraft, a derivative model of the GVI aircraft. Petition for Permanent Partial Exemption – Gulfstream Aerospace Corporation – Lightning Protection of Fuel Tank Systems and Structure – Model GVIII-G800 is provided in support of this request (Enclosure 1).

Gulfstream believes that good cause exists why action on this petition should not be delayed by publication and comment procedures. We request that the 120-day FAA review and processing period specified in 14 CFR 11.63(d) be reduced to 60 days. Gulfstream feels this request is

appropriate as it does not set a precedent and because the relief requested herein is identical to exemptions granted previously (References 1-3).

Should you have any further questions, or require any additional information, please contact CAO Airworthiness Engineering Specialist Andrea Burkhardt at Andrea.Burkhardt@gulfstream.com or (912) 251-1712 (office), or the TC Program Administrator Tom Strohmayer at Thomas.Strohmayer@gulfstream.com, (912) 395-7778 (office) or (912) 433-6002 (mobile).

Respectfully,

Catherine M. Downen
ODA Enterprise Program Administrator - TC
Gulfstream Aerospace Corporation

Petition for Permanent Partial Exemption
Gulfstream Aerospace Corporation
Lightning Protection of Fuel Tank Systems and Structure
Model GVIII-G800

This petition is to amend Exemption 10387B to include the model GVIII-G800.

Relief from Section 14 CFR Part § 25.981(a)(3) Amendment 25-102

Gulfstream Aerospace Corporation (Gulfstream) of Savannah, Georgia has submitted an application to the FAA's Atlanta Aircraft Certification Office for amended type certification of a GVI derivative product of similar design and manufacture to be known as the Gulfstream model GVIII-G800. Project number AT-01-2015-0017 has been assigned to these efforts.

14 CFR § 25.981(a)(3), Amendment 25-102 requires that "(a) No ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. This must be shown by: […] (3) Demonstrating that an ignition source could not result from each single failure, from single failure in combination with each latent failure condition not shown to be extremely remote, and from all combinations of failure not shown to be extremely improbable. The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered."

The FAA has issued Policy Statement PS-ANM-25.981-02 to address the impracticality of compliance to 14 CFR § 25.981(a)(3) Amendment 25-102 or later with regards to lightning protection of fuel tank structure and systems. This policy provides guidance for applicants to obtain a permanent partial exemption by applying the following ignition source prevention conditions:

(1) The fuel tank structure and systems must be designed and installed to prevent catastrophic fuel vapor ignition due to lightning.

(2) The fuel tank structure and systems lightning protection design must be fault tolerant for failures that result in lightning-related ignition sources.

(3) Fault tolerance is not required for any specific feature if:

    (a) Fault tolerance is shown to be impractical for that feature, and

    (b) Fuel tank vapor ignition because of that feature and all other non-fault-tolerant features, when their fuel tank vapor ignition event probabilities are combined, is shown to be extremely improbable.

(4) Inspections or other procedures must be established to prevent development of lightning-related ignition sources within the fuel tank structure and systems, for example:

    (a) Identifying as airworthiness limitations, mandatory maintenance actions (i.e., inspections), or critical design configuration control limitations (CDCCLs), necessary to

preclude the development of unsafe conditions due to non-fault-tolerant lightning protection features;

(b) Including sampling programs, maintenance, and/or inspections for fault-tolerant lightning protection features in the manufacturer's recommended airplane maintenance program;

Note: If inspections from non-mandatory programs such as Baseline Zonal inspection program, Corrosion Prevention and Control Program (CPCP), etc., are going to be used to support the robustness of the overall inspection program, these programs must become mandatory and must be included in the Airworthiness Limitations section of the airplane's Instructions for Continued Airworthiness.

(c) Incorporating into applicable airplane maintenance documents, including the manufacturer's structural repair manual, caution information that identifies the lightning protection features of the fuel system design to minimize the potential for inadvertent damage or disruption of these features.

(5) An analysis must be performed to show that the airplane's design, its manufacturing processes, and the Airworthiness Limitations section of its Instructions for Continued Airworthiness include all practical measures to prevent, and detect and correct, failures of fuel tank structure and systems lightning protection features because of manufacturing variability, aging, wear, corrosion, and likely damage.

After consideration of the FAA policy and review of the Model GVIII-G800 design, Gulfstream has determined that compliance with 14 CFR § 25.981(a)(3) for certain system and structural lightning protection features is impractical. In accordance with the provisions of 14 CFR 11.81, and the guidance of FAA Policy Statement PS-ANM-25.981-02, Gulfstream requests a permanent partial exemption for certain system and structural aspects of 14 CFR § 25.981(a)(3) at Amendment 25-102. Granting this permanent partial exemption would permit type certification of the Gulfstream Model GVIII-G800.

Discussion

The Model GVIII-G800 is a twin-engine, transport category aircraft derived from the GVI airplane. The GVIII-G800 fuel storage system is a two-tank system. Each fuel tank is located in the respective left or right wing; the left tank provides fuel feed lines to the left engine and the APU, and the right fuel tank provides fuel feed lines to the right engine. The wing of the Model GVIII-G800 is of a traditional metal structure and the wing fuel tank is identical to the GVI and GVIII-G700 wing fuel tank. There are no other fuel tanks present in the aircraft.

Changes to the GVIII-G800 wing and fuel tank structure with respect to GVI are limited to:

- A new winglet shape with unchanged mechanical attachment to the wing structure;

- Web and stiffener thickness increase at certain wing ribs with unchanged mechanical attachment to the wing skin;
- Isolated fastener changes from index head rivets to Hi-Lites on one lower skin stringer;
- Local doubler added to one upper vent stringer;
- Stiffener added to the rear spar in the vicinity of the sponson.
- Bonding straps from the wing to the fuselage for indirect effects of lightning improvement, located on the upper surface of the wing and underneath the wing to body fairing panel.

With respect to GVI, systems changes are limited to new and rerouted elements in the pylon area; GVIII-G800 changes in the pylon area are the same as changes in GVIII-G700 pylon area. There are no changes to any system elements within or attached to the wing fuel tank.

Structure

Gulfstream will provide fault tolerant lightning protection features for the fuel tank structure except in areas where Gulfstream can substantiate that compliance to 14 CFR §25.981(a)(3) for fuel tank structural fastener lightning protection is impractical. It is the latent nature of the potential failures associated with structural elements that make compliance impractical. Gulfstream is not aware of any feature or system that could be installed that would monitor and notify the pilot in the event of a failure of structural lightning protection features. Physical inspections are the only means to determine the continuity of these protection features. However, the fasteners and the associated lightning protection features are internal to and integral to the aircraft structure and therefore these inspections require access to the fuel tank. Some of these inspections would require disassembly of tank structure to determine conditions such as fastener clearance or interference fit that can have a significant impact on ignition source creation or prevention. While reducing the intervals of possible inspections would reduce exposure of the latent nature of the associated failure modes, such inspections could also potentially introduce damage to the lightning protection features, damage to other components within the wing, or introduce foreign object debris into the wing. Latent structural cracks or broken fasteners internal to the tank will also depend on inspections for detection. Any cracks or broken fasteners that are at the tank boundaries at or below fuel level would cause visible fuel leakage and be repaired using the established lightning protection processes. Potential cracks in structure or broken fasteners internal to the fuel tank will be addressed based on the maintenance and inspection intervals established in the GVIII-G800 Critical Design Configuration Control Limitations (CDCCL) for 25.981.

Systems

Gulfstream has determined that additional relief from full compliance to 14 CFR § 25.981(a)(3) is necessary for some system aspects. It is the latent nature of potential failures associated with system design elements and the installation that make compliance to 14 CFR § 25.981(a)(3) impractical. As an example, Gulfstream has identified that the flexible fuel line couplings, as a result of certain specific failure modes, could create an ignition source if subjected to high levels of lightning conducted currents. Although some faults would be detected due to the effect on the fuel distribution system, some failures

may be latent. Gulfstream has determined that it is impractical to install couplings that are designed to prevent this potential fault. At present, couplings that are fully 25.981(a)(3) compliant are not yet fully developed within the industry and not qualified for aerospace usage. As another example, fuel tank access panels are considered as system elements due to the expectation of being disturbed for maintenance purposes. The GVIII-G800 wing, which is identical to the GVIII-G700 wing, is the same as GVI wing with the minor exceptions noted above. The FAA has determined that compliance to 14 CFR § 25.981(a)(3) for the fuel tank access panels is impractical as documented in Permanent Partial Exemption No. 10387B for the GVI (revision B added the GVIII-G700). Gulfstream will show the design for the GVIII-G800 fuel tank access panels, which are unchanged from the GVIII-G700 and GVI, will provide an appropriate level of protection against lightning induced fuel tank ignition and will be shown to comply with the alternative criteria provided in FAA Policy No. PS-ANM-25.981-02. As indicated for Structural aspects, any inspection requirements for system aspects, as appropriate, will be addressed based on the maintenance and inspection intervals established in the GVIII-G800 Critical Design Configuration Control Limitations (CDCCL) for 25.981.

FAA Policy Statement PS-ANM-25.981-02, dated June 24, 2014 provides a means of applying special conditions, exemptions, or the changed product rule as alternatives to direct compliance to the provisions of 14 CFR § 25.981(a)(3) at Amendment 25-102, or later, for lightning protection of fuel tank systems and structure. The FAA developed the latest policy as it was determined that compliance with current regulatory standards applicable to fuel tank lightning protection can be impractical in some cases for some areas of structural design. In addition, the industry has requested that the FAA consider extension of such practicality considerations to the design of fuel tank systems. Therefore, Gulfstream respectfully requests a permanent partial exemption for certain system and structural aspects of 14 CFR § 25.981(a)(3) at Amendment 25-102. Gulfstream intends to apply the proposed permanent partial exemption for the structure and systems discussed above. As Gulfstream intends to use this wing design on the GVIII-G800 and in the ongoing production of the GVI where regular attention to product improvements and design change initiatives might invoke changes to fuel system elements applicable to this requirement, Gulfstream requests that this permanent partial exemption be written to apply, in general, to other fuel tank systems, and inclusive of the flexible couplings and wing access panels.

Supportive Information

As a result of the 1996 explosion of the center wing fuel tank of TWA flight 800, resulting in the loss of the airplane and 230 deaths, in 2001 the FAA issued amendment 25-102 to 14 CFR part 25. This rule was entitled Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements (Docket No. FAA-1999-6411) and added specific ignition-prevention requirements and a new flammability-minimization requirement to 14 CFR § 25.981.

The amended ignition-prevention requirements in § 25.981(a)(3) required applicants to consider factors such as aging, wear, and maintenance errors, as well as the existence of single failures, combinations of failures, and latent failures that may be the cause of ignition sources in fuel tanks.

Section 25.981 at amendment 25-102 required that fuel tank designs for transport category airplanes protect from the effects of lightning with features that are fault tolerant. Prior to amendment 25-102, the FAA had not required applicants to consider anticipated design failures, aging, wear, or maintenance errors because § 25.954 had been the standard that the FAA applied to lightning protection of fuel tanks.

When amendment 25-102 made § 25.981 applicable to the structural lightning protection aspects of new airplane designs, applicants found that it was impractical for certain fuel tank structure to meet the standard, and to incorporate the required additional protective features.

The FAA agreed that it could be impractical to meet the requirements of § 25.981(a)(3) for certain areas of structural design. Therefore, in 2007 the FAA began granting exemptions and special conditions that allowed applicants to show compliance based on design features that increased the level of safety while not showing full compliance with the requirements of § 25.981(a)(3). Specifically, the FAA accepted fault-tolerant designs for fuel tank structure where the applicant could show that it was impractical to provide an additional layer of protection.

The energy from a lightning strike can be transferred to fuel tanks installed in wings through fasteners and other structural elements. It can be impractical, the FAA found, to provide either continuous monitoring of the "health" of the lightning-protective features for these structures or to inspect the features frequently enough to detect latent failures. These features are typically integral to the fuel tank structure or internal to the fuel tank, requiring access into the tank to verify the integrity of the feature. Inspections of fuel tank structure, requiring fuel tank entry, may be scheduled only once or twice during the life of the airplane.

It soon became apparent to the FAA that the agency needed consistency in its methodology for analyzing such structures. Therefore, in 2009 the FAA issued Policy No. ANM-112-08-002, *Policy on Issuance of Special Conditions and Exemptions Related to Lightning Protection of Fuel Tank Structure*. This policy provided standardized criteria for the granting of exemptions and issuance of special conditions for structural lightning protection.

In 2014, the FAA superseded the 2009 policy with Policy No. PS-ANM-25.981-02, Policy on Issuance of Special Conditions and Exemptions Related to Lightning Protection of Fuel Tank Structure and Systems (issued June 24, 2014). This policy contained the criteria the FAA would consider in analyzing requests for exemption from § 25.981(a)(3) when applicants contended it was impractical to comply with the ignition-prevention requirements relating to lightning protection of not only fuel tank structure, but also fuel tank systems.

The primary differences between the 2009 and 2014 policies were—

(1) The expansion of the applicability of the policy from fuel tank structure, to fuel tank systems, for areas of systems design where the applicant shows that compliance with § 25.981(a)(3) is impractical.

(2) The addition of criteria for evaluating the practicality of direct compliance to § 25.981(a)(3). The 2014 policy defined "practicality" as a balance of available means, economic viability, and proportional benefit to safety.

(3) The addition of criteria for establishing inspection requirements for structural failures that could result in an ignition source.

Shortly thereafter, the FAA proposed to convert the principles of this policy to Federal Aviation Regulations. In December of 2015, the FAA issued a notice of proposed rulemaking to amend §§ 25.954 and 25.981 and appendix H to part 25 (79 FR 75496-75505). After receiving and analyzing the public comments, the FAA issued a final rule in 2018 (Amendment 25-146, 73 FR 42494).

For the GVIII-G800 aircraft, Gulfstream believes the design for the fuel tank structure and systems discussed above will provide an appropriate level of protection against lightning induced fuel tank ignition and will comply with the alternative criteria provided in FAA Policy Statement PS-ANM-25.981-02.

Factors Supporting the Petition

The design features of the GVIII-G800 fuel tank are identical to those described in Exemption 10387B for the GVI and GVIII-G700.

In accordance with FAA Policy Statement PS-ANM-25.981-02, Gulfstream will demonstrate that the GVIII-G800 utilizes state-of-the-art industry design and manufacturing techniques. Within the fuel tank structure, these ensure inherently conductive, low resistance, current paths that have been used in existing in-service designs. Gulfstream will enhance these protection features in areas of potential direct attachment of lightning strikes and swept lightning current by over-coating the fasteners with a protective layer of fuel tank sealant.

FAA Policy Statement PS-ANM-25.981-02 identifies the following ignition source prevention conditions to ensure that an acceptable level of safety is provided:

(1) The fuel tank structure and systems must be designed and installed to prevent catastrophic fuel vapor ignition due to lightning.

The GVIII-G800 fuel tank structure and its lightning protection capability is unchanged from that which has been substantiated in the type certification process for the GVI to prevent catastrophic fuel vapor ignition due to lightning. The GVIII-G800 fuel tank systems – namely, the wing access panels and flexible couplings, include all practical means to prevent vapor ignition due to lightning.

(2) The fuel tank structure and systems lightning protection design must be fault tolerant for failures that result in lightning-related ignition sources.

Gulfstream demonstrated that the GVI fuel tank structure lightning protection design is fault tolerant for failures that could result in lightning related ignition sources per Exemption No. 10387 during the type certification process for the GVI. Gulfstream will demonstrate that the GVIII-G800 access panel design, which is the same as that which has been certified on the GVI, is sufficiently fault tolerant to provide an acceptable level of safety in accordance with the current FAA Policy Statement.

(3) Fault tolerance is not required for any specific feature if:

(a) Fault tolerance is shown to be impractical for that feature, and

(b) Fuel tank vapor ignition because of that feature and all other non-fault-tolerant features, when their fuel tank vapor ignition event probabilities are combined, is shown to be extremely improbable.

Gulfstream understands the requirements for fault tolerance, as outlined in granting of Exemption No. 10387B. Gulfstream is not proposing any change to the fault tolerance requirements. Gulfstream intends to verify that the GVIII-G800 fuel tank structure and systems will satisfy the prescribed fault tolerance criteria in accordance with Exemption No. 10387B.

(4) Inspections or other procedures must be established to prevent development of lightning-related ignition sources within the fuel tank structure and systems, for example:

(a) Identifying as airworthiness limitations, mandatory maintenance actions (i.e., inspections), or critical design configuration control limitations (CDCCLs), necessary to preclude the development of unsafe conditions due to non-fault-tolerant lightning protection features;

(b) Including sampling programs, maintenance, and/or inspections for fault-tolerant lightning protection features in the manufacturer's recommended airplane maintenance program;

Note: If inspections from non-mandatory programs such as Baseline Zonal inspection program, Corrosion Prevention and Control Program (CPCP), etc., are going to be used to support the robustness of the overall inspection program, these programs must become mandatory and must be included in the Airworthiness Limitations section of the airplane's Instructions for Continued Airworthiness.

(c) Incorporating into applicable airplane maintenance documents, including the manufacturer's structural repair manual, caution information that identifies the lightning protection features of the fuel system design to minimize the potential for inadvertent damage or disruption of these features.

Gulfstream understands the requirements for inspections or other procedures to be established to prevent development of lightning-related ignition sources within the fuel tank structure and systems. Appropriate airworthiness limitations, inspection instructions, mandatory maintenance actions and CDCCLs will be addressed for the GVIII-G800 program.

Gulfstream successfully applied the required criteria to the GVII model aircraft based on Exemption No. 17636A that was granted for that family, inclusive of the fuel system and structure elements allowed per FAA Policy Statement PS-ANM-25.981-02. Gulfstream intends to take the same approach with the structure and systems aspects for the GVIII-G800 in accordance with Exemption No. 10387B and to invoke the same FAA Policy Statement. Specifically, Gulfstream intends to add verbiage to the GVIII-G800 Airplane Maintenance Manual (AMM), similar to that which was included in the GVII AMM, enforcing the importance of following proper procedures for removal and reinstallation of the access panels to ensure lightning protection features are preserved.

(5) An analysis must be performed to show that the airplane's design, its manufacturing processes, and the Airworthiness Limitations section of its Instructions for Continued Airworthiness include all practical measures to prevent, and detect and correct, failures of fuel tank structure and systems lightning protection features because of manufacturing variability, aging, wear, corrosion, and likely damage.

Gulfstream intends to incorporate into the GVIIII-G800, a design that is known to include all practical measures known at this time to prevent and detect and correct failures of the fuel tank systems lightning protection features because of the listed potential issues. The manufacturing processes and Airworthiness Limitations will be reviewed by Gulfstream for completeness to ensure they include all practical measures to prevent, and detect and correct, failures of fuel tank structure and systems lightning protection features because of manufacturing variability, aging, wear, corrosion, and likely damage.

Effect of the Exemption on Safety

The proposed GVIII-G800 permanent partial exemption allows the same approach to GVI, GVII, and GVIII-G700 lightning protection that is less susceptible to inadvertent failure conditions that could result in ignition sources as compared with a supposed compliant design that would necessarily be more complex.

Issue of Public Interest

Gulfstream Aerospace Corporation designs, develops, manufactures, markets and services the world's most technologically advanced business jet aircraft to an international market. Gulfstream's leadership position in the global business jet market is due to the efforts of its nearly ten thousand employees in the manufacturing plants, completion centers, and service centers across North America. The corporation utilizes numerous products, such as avionics and environmental control systems, from scores of suppliers located throughout the United States. Gulfstream competes for new business all

over the world. This partial exemption will directly impact the ability to certify the Gulfstream Model GVIII aircraft thereby having a direct effect on GVIII-G800 sales. The manufacture, completion, and support of Gulfstream aircraft would aid in the stabilization of the job market as well as growth of the American economy, which is in the interest of the public.

As stated in FAA Policy Statement PS-ANM-25.981-02, both the FAA and industry have determined that full compliance to 14 CFR 25.981(a)(3) at amendment 25-102 is impractical. In granting permanent partial exemption 10387B for the GVI (revision B added the GVIII-G700), the FAA accepted the fault-tolerant designs for fuel tank structure where Gulfstream could show that it was impractical to provide an additional layer of protection. In addition, full compliance would be impractical because it would necessitate design changes that would increase the complexity of the design, the manufacturing process, and maintenance requirements, without a proportional benefit to safety. Gulfstream believes the proposal made herein is consistent with the expectations defined by the FAA in their policy. Requiring the Model GVIII-G800 to fully comply with 14 CFR § 25.981(a)(3) would prevent Gulfstream from certifying the aircraft on a timely and competitive schedule, putting it at an unfair disadvantage to its competitors. Finally, full compliance would delay the benefit of other safety features introduced by this product and advancements in fuel efficiency. Increasing safety and environmental health are certainly in the interest of the public.

Operation Outside the United States

In accordance with the provisions of 14 CFR 11.81(h), Gulfstream requests that consideration be given to extending this partial exemption for operation outside of the United States. Gulfstream aircraft are routinely registered and operated outside of the United States and projections are the same for the Model GVIII-G800. Granting this extension of privileges will allow for operations based within foreign countries, having bilateral agreements with the United States accepting FAA 14 CFR Part 25 as their airworthiness standard for transport category aircraft. Gulfstream believes that limiting this exemption to use within the United States would put unfair restrictions on the marketability of this aircraft.

Conclusion

Gulfstream believes that the above arguments favor an amendment to Exemption 10387B to include the model GVIII-G800 by providing an exemption from 14 CFR 25.981(a)(3). The proposed design for the GVIII-G800 fuel tank structures, which is identical to GVIII-G700 fuel tank structures, will provide an appropriate level of protection against lightning induced fuel tank ignition and will be shown to comply with the alternative requirements provided in FAA Policy Statement PS-ANM-25.981-02. The proposed design for the GVIII-G800 fuel tank systems, which is identical to GVIII-G700 fuel tank systems, will provide an appropriate level of protection against lightning induced fuel tank ignition, and where shown not to be in direct full compliance with the rule, will be shown to comply with the alternative requirements provided in FAA Policy Statement PS-ANM-25.981-02. Accordingly, Gulfstream believes that an exemption is in the public interest and will provide a level of passenger safety consistent with the current 14 CFR Part 25 regulations.